

WASHINGTON WATER POWER CLARK FORK RIVER
NOXON RAPIDS HYDROELECTRIC DEVELOPMENT,
POWERHOUSE

South Bank of Clark Fork River at
Noxon Rapids
Noxon vicinity
Sanders County
Montana

HAER No. MT-105-A

HAER
MONT
45-NOX V,
1A-

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

HISTORIC AMERICAN ENGINEERING RECORD
Columbia Cascades Support Office
National Park Service
909 First Avenue
Seattle, Washington 98104-1060

**HISTORIC AMERICAN ENGINEERING RECORD
WASHINGTON WATER POWER CLARK FORK RIVER
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Location: The south bank of the Clark Fork River at Noxon Rapids, Noxon vic., Sanders County, Montana, 18.5 miles upstream of the Montana-Idaho state line.

Date of Construction: 1956-1959

Engineer: J. G. Roberts (Resident Engineer, Dam)

Builder: Ebasco Services (General Contractor)

Present Owner: Avista Corporation

Present Occupant: Avista Corporation

Present Use: Hydroelectric Generation Facility

Significance: The Noxon Rapids Powerhouse is locally important because of its influence, along with the associated Noxon Rapids Hydroelectric Development, on the local environment, landscape and economy. The facility is also important in the history of the Washington Water Power Company, now Avista Corporation. The powerhouse interior equipment represents late 1950s state of the art technology, now obsolete and soon to be replaced and upgraded with 1990s technology. The powerhouse was recommended eligible for inclusion in the National Register of Historic Places in 1998.

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NOTE: See field notes for figures called out in text.

I. NOXON RAPIDS DAM ENGINEERS AND CONTRACTORS

The Washington Water Power Company (now Avista Corporation) of Spokane, Washington, formally contracted with Ebasco Services Incorporated (Ebasco) of New York, New York, for engineering and construction management services for building the Noxon Rapids Hydroelectric Development on March 1, 1955. Construction activities started on August 17, 1955, with reservoir clearing. Construction activities were completed on July 9, 1960, when the dedication ceremonies were held at the facility (Roberts et al. 1960:1-2).

The dam, powerhouse, switchyard, and their support facilities were designed by the Ebasco Engineering Department in New York. Construction contracts and purchases were awarded in the form of Ebasco New York Purchase Orders, Ebasco Field Contracts, and the Washington Water Power Company Contracts. Coordination between Ebasco and the Washington Water Power Company (WWP) was supervised by Mr. K. O. Strenge, WWP Chief Civil Engineer. All construction activity was under the general direction of Ebasco Construction Manager Mr. F. C. Schlemmer, and his assistant managers Mr. H. S. Floyd and his successor Mr. A. F. Coffey. The Ebasco Project Engineer was Mr. R. A. Sutherland, who prepared designs, did consultation work with WWP and the Ebasco field staff, and coordinated the initial start-up of the turbines. Project public relations, clarification of property purchases and final inspection of reservoir clearing was handled by Engineering Coordinator Mr. T. H. Judd and his successor Mr. K. J. Karp. Technical guidance for the concrete program was provided by Mr. D. L. Houghton, a General Concrete Engineer. Various Ebasco field supervisory personnel had responsibility for daily operations at the Noxon Rapids construction site. All phases of the project field activities were under the supervision of Project Manager Mr. F. L. Weiss and his assistant Mr. P. L. Guthrie. Other key field personnel included Resident Engineers Mr. J. G. Roberts -- Dam and Powerhouse, W. L. Searce -- Reservoir, and E. D. McKeithan -- Reservoir (Roberts et al. 1960:15-16).

The primary construction contractor for the dam and powerhouse was the Morrison-Knudsen Company. Much of the electrical work at the powerhouse was done by the Morgan Electric Company. Special construction assistance was provided by the General Electric Corporation, Westinghouse Electric Corporation, and Allis-Chalmers Corporation.

II. NOXON RAPIDS POWERHOUSE STRUCTURAL INFORMATION

The Noxon Rapids Powerhouse is a semi-outdoor type structure designed by Ebasco Services Incorporated of New York. The powerhouse consists of a

mass concrete substructure founded on bedrock at about elevation 2110' and a reinforced concrete superstructure that measures 485' N-S and 105' 9" E-W (Roberts et al. 1960:26). The draft tubes and scroll cases are embedded in the mass concrete substructure below the operating floor and a roof deck containing the generator housings and transformers is located above the operating floor (i.e., a semi-outdoor type structure). Structural concrete work on the powerhouse was started on August 22, 1957, and completed on March 26, 1959, with wearing surface concrete work completed on July 3, 1959. A total of 69,952 cubic yards of concrete (including 9,213 cubic yards for the erection bay and unloading platform) and 3,220,977 pounds of reinforcing steel were used in the powerhouse construction (Roberts et al. 1960:29). The powerhouse concrete work was performed by the Morrison-Knudsen Company as part of Ebasco contract NRC-17, with the placement of reinforcing steel performed by Gilmore-Skoubye under subcontract to Morrison-Knudsen Company (Roberts et al. 1960:28-29).

Stairway access to the powerhouse interior is gained through two concrete penthouses, one on the roof deck near Unit 4 and one at the unloading platform. An elevator from the top of the dam provides access to the powerhouse interior through an access gallery. The powerhouse interior architectural finish work was performed by Allen Building Contractors under contract NRC-92, Val Pagnutti & Company under contract NRC-96, and the Springer Painting Company under contract NRC-95 (Roberts et al. 1960:30-31).

Allen Building Contractors finished the interior partitions, floors and ceilings in the control room, meeting room (now the communications room), Chief Operator's office, kitchenette, Superintendent's office, toilet and locker and shower room. The interior partitions for the battery room, meeting room, Superintendent's office, Chief Operator's office, switch gear rooms 1 and 2 (also known as motor control centers 1 and 2), small storage room and closets are constructed of 4" pumice block walls. Structural glazed tile was used in the walls of the toilets, locker room and kitchenette. The control room walls consist of a structural glazed tile wainscot with sanicoustic panels above. The corridor walls are finished with plaster. The battery room floor, along with the floors in the kitchenette, toilets, locker room and air conditioning room are terrazzo with terrazzo cove base and 16-gauge white metal strips that divide the floors into approximately 3' square panels. The Chief Operator's office, control room, meeting room (now the communications room) and Superintendents' office floors are of 2" cement finish covered with rubber tile with a rubber cove base. The control room has a suspended sanicoustic panel ceiling with a central louverall lighting installation. Suspended sanicoustic panels are also used for the ceiling cover in the Chief Operator's office, Superintendent's office and the

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meeting room. Suspended plaster ceilings are located in the locker room, toilets, kitchenette and corridor. This work was started by Allen Building Contractors in March 1959, and completed in September 1959 (Roberts et al. 1960:30-31).

The remaining powerhouse floors were finished by Val Pagnutti & Company under contract NRC-96. All of the remaining floors (i.e., hallways, lunchroom, entryways, etc.) were finished in terrazzo with terrazzo cove base and 16-gauge white metal strips that divide the floors into approximately 3' square panels, with the exception of the erection bay and the compressor rooms. The erection bay and compressor rooms have cement finish floors reinforced with welded wire mesh and sisal craft paper to prevent foundation cracks from carrying through the floor. This work was started by Val Pagnutti & Company in November 1959, and completed in May 1960 (Roberts et al. 1960:31).

Springer Painting Company completed the main painting program under contract NRC-95, with additional paint work performed by Hunter & Tate. The painting program consisted mostly of interior work, and used a variety of materials and colors. The powerhouse interior operating floor is primarily painted with industrial green and pink lead based paint. Other painting included red lead based paint for the scroll case interior, aluminum applied to the generator housings and Zolatone applied to three rooms in the vicinity of the control room (Roberts et al. 1960:31).

Doors throughout the powerhouse are all of hollow core metal construction, some with and some without glass. Exterior glass windows were also installed in the penthouse entryways, as well as an interior glass panel between the control room and the meeting room (now used as a communications room). The interior doors and window were installed by Allen Building Contractors under contract NRC-92. The exterior doors and windows were installed by Morrison-Knudsen Company under contract NCR-17.

III. NOXON RAPIDS POWERHOUSE EQUIPMENT TECHNICAL INFORMATION

The primary station control equipment and operating machinery are located on the powerhouse operating floor (see photograph MT-105-A-32). This equipment and machinery includes the turbines, generators, governors, voltage regulators, main control switchboard, station service control and central greasing system. All remaining interior equipment dating to the historic period of the powerhouse, 1955-1960, as well as selected equipment associated with Unit 5 that was installed 1976, has been photo documented and is described below. In some instances components of the original equipment have been

replaced by new components as a result of normal operating use. Note that only one example of duplicated equipment, such as governor housings, turbine pits, and motor control centers, was photographed.

Main Control Switchboard

The main control switchboard monitors and regulates the electrical function and output of the facility (Figure 1). The original main control switchboard was manufactured by the Westinghouse Electric Corporation under Ebasco. The switchboard was manufactured to specification No. W-205-SB, dated March 12, 1956, and revised on June 11, 1956, January 9, 1957, and July 23, 1957. The specifications called for:

an enclosed switchboard with complete equipment for protection, operation, control, indication and metering for four 70,720 kw, 0.8 pf, 88,400 kva, 3 phase, 60 cycle, 14,400 volt water wheel generators, with grounded neutrals, two banks of three 66,300 kva, 13.2 - 230 kv, 1 phase, 60 cycle transformers, two 1,500/1725 kva, 14,400 - 480 volt, 3 phase, 60 cycle, station service transformers and four 230 kv transmission lines, together with attendant auxiliary apparatus, accessory equipment and materials as may be required for a complete self-contained installation, whether or not specifically mentioned in this specification (Ebasco Service 1957:[1]).

The switchboard cabinet is made of combined bench sections and enclosed steel duplex sections of truncated prismatic form as shown on sketch SK-4185-E-1. The switchboard cabinet is comprised of 14 sections. Sketch SK-4185-E-1 identifies the original sections as items 1 through 13. Item 1 is the synchronization monitor; item 2 is the load frequency control panel, which regulates unit start-up, CO₂ protection, etc.; item 3 is the general station control panel, which regulates in-plant electrical distribution; item 4 is the generator Unit 1 control panel; item 5 is the generator Unit 2 control panel; item 6 is the generator Unit 3 control panel; item 7 is the generator Unit 4 control panel; item 8 is the generator Unit 5 control panel (controls installed in 1976); item 9 is the Hot Springs No. 2 transmission line panel (controls installed in 1976); item 10 is the Bell transmission line panel; item 11 is the Hot Springs No. 1 transmission line panel; item 12 is the Cabinet Gorge transmission line panel; and item 13 is the Pine Creek transmission line panel. Item 14, the Libby transmission line

panel, located on the north end of the switchboard, was added in 1976. Items 2 through 14 are floor standing cabinet sections. Item 1 is not a floor standing cabinet section.

Item 1 measures 1' wide by 1' 7.5" tall and is attached to the left side of the Item 2 duplex section. The bench section of item 2 measures 2' deep, 1' 9" wide by 2' 10" tall at the outer edge, and 2' wide by 3' 2" tall at the inner edge, where the bench and the duplex section attach. The attached duplex section of item 2 measure 2' wide, 6' deep and 7' 6" tall. The bench sections of items 3 through 13 measure 2' deep, 1' 3" wide by 2' 10" tall at the outer edge, and 1' 6" wide by 3' 2" tall at the inner edge, where the bench and the duplex section attach. The attached duplex sections of items 3 through 13 measure 1' 6" wide, 6' deep and 7' 6" tall. The cabinet has filler pieces between the duplex sections and steel channel sills that form a rigid, self-supporting structure. The switchboard has two doors, one at each end, that provide access to the interior. The switchboard cabinet has an "Indoor Light Gray ASA No. 61" satin exterior finish and a light gray interior finish (Ebasco Services 1957:7). The bench section of item 14 measures 2' deep, 1' 9" wide by 2' 10" tall at the outer edge, and 2' wide by 3' 2" tall at the inner edge, where the bench and the duplex section attach. The attached duplex section of item 14 measure 2' wide, 6' deep and 7' 6" tall.

The original instruments, annunciator, relays and meters have a dull black finish. The instruments and meters also have standard white scales with black numerals and markings. All of the major equipment and control circuits are marked by black nameplates with white lettering. The cabinet benches have control devices (i.e., switches) mounted on them. The front of the duplex panels also have control devices (i.e., switches) mounted on them, as well as indicating instruments (i.e., readout displays). The rear of the duplex panels are mounted with voltage regulators, integrating meters and relays. See photographs MT-105-A-3 to MT-105-A-6.

Generators

The Noxon Powerhouse was originally equipped with four vertical water-turbine-driven alternating current generators manufactured by General Electric Company of Schenectady, New York, and purchased by Ebasco under contract NY-90202. The generators are designated Units 1, 2, 3 and 4, and have the following serial numbers: Unit 1 = #6999893; Unit 2 = #6999894; Unit 3 = #6999895; Unit 4 = #6999896. The generators were manufactured according to Ebasco specification No. W-200-G, dated February 6, 1956, and revised June 13, 1956, and June 25, 1957. Each of the four original generators is a Type

ATB-W-72 pole with the following specifications: "88,400 kva, .8 pf, 100 rpm, 14,400 volts, 3 phase, 60 cycles, (70,720 kw, 3,544 amp arm, 1,050 amp field) with Type EVF-12, 12 pole, and Type EV-11, 6 pole, 14 kw, 250 volts, 100 rpm compound wound pilot exciters" (Roberts et al. 1960:58). The generators are enclosed in outdoor type weatherproof metal housings located on the powerhouse roof deck.

Installation of the generators was performed by Morgan Electric Company under contract NRC-86 and supervised by a General Electric field representative. Installation of the generator units began on October 27, 1957 and was completed on July 5, 1959 (Roberts et al. 1960:58). Mechanical run tests began on July 8, 1959, and were completed on March 18, 1960. The units began commercial operation as follows: Unit 1 - September 1, 1959; Unit 2 - October 20, 1959; Unit 3 - December 1, 1959; and Unit 4 - April 1, 1960 (Roberts et al. 1960:60).

The Unit 2 generator was rewound in 1992 by the Westinghouse Electric Corporation. The new stator coils were manufactured by the Westinghouse Toronto plant in Ontario, Canada, and installed by Eastern Electric Apparatus Repair Services Company. Upon completion of the generator rewind, Unit 2 specifications increased to 96,000 kva; 76,800 kw; 3,850 amps. According to Avista Corporation Chief Generation Engineer Steve Wenke, Unit 1 generator was rewound in 1979, Unit 3 generator was rewound in 1983 and Unit 4 generator was rewound in 1975, though no other documentation about these rewinds was available or displayed on the unit housings (Steve Wenke, personal communication 1999). The generator rewinds have not altered the external appearance of the units.

A fifth generator unit was installed in 1976. The Unit 5 generator, serial #8383724, is a Type ATI alternating current (AC) generator manufactured by General Electric Company. The Unit 5 manufacturers plaque, located in the Noxon powerhouse, lists the following generator specifications: 120,000 kva, .95 pf, 105.9 rpm, 14,400 volts, 3 phase, 60 cycles, 114,000 kw, 4,811 amp arm, 1,255 amp field. Unit 5 became operational in 1977. See photographs MT-105-A-8 to MT-105-A-10, MT-105-A-26 to MT-105-A-27 and MT-105-A-29.

Turbines

The original Noxon Powerhouse construction plans called for installation of four turbines, plus the construction of one open bay for the future installation of a fifth turbine. The original four turbines installed were single runner, vertical shaft, Francis-type hydraulic turbines capable of 100 revolutions per minute (rpm),

130,800 hp* at 152 foot head. These turbines were manufactured by the Allis-Chalmers Manufacturing Company of Milwaukee, Wisconsin, in accordance with Ebasco specification No. WAS-4185-CE-1 and purchased under order NY-90201. The turbines are designated Units 1, 2, 3 and 4, and have the following serial numbers: Unit 1 = #1305; Unit 2 = #1306; Unit 3 = #1307; Unit 4 = #1308. The turbine Units were installed by the Morgan Electric Company of Seattle, Washington, under contract NRC-70 (Roberts et al. 1960:56). See photographs MT-105-A-11 to MT-105-A-14.

Governors

A governor monitors and controls the speed of the turbine and generator system. The original governing equipment consists of two twin actuator and pump cabinets installed in 1959, one each located between Turbine Units 1 & 2 and Turbine Units 3 & 4. Equipment contained within the governor housing includes speed limit and gate limit motor positions, generator air brake valve, oil pumps, motors, and pump controls for regulation and monitoring of fluid levels (Figures 2-4). The governor cabinets also house indicators for the generator guide and thrust bearing temperatures, turbine guide bearing temperature and oil pressure and penstock pressure. Governor Units 1-4 were manufactured by the Allis-Chalmers Company. Unit 5 has a single actuator and pump cabinet that was manufactured by the Woodward Company and installed in 1976. See photographs MT-105-A-15 and MT-105-A-30.

Governor Accumulator Tanks

Pressure within the hydraulic fluid system is maintained by high pressure accumulator tanks connected to each governor system. There are a total of five accumulator tanks. Two accumulator tanks are located directly behind each of the governor cabinets on Units 1 & 2 and 3 & 4 (Figures 3-4). Unit 5 has one accumulator tank located behind the governor cabinet. Each tank regulates fluid pressure within its associated system. The accumulator tanks for Units 1-4 were manufactured in 1958 and rated to a maximum design pressure of 385 psi at 650 degrees Fahrenheit and a working pressure of 350 psi. High pressure air for each of the accumulator tanks on Units 1-4 is supplied by Worthington model 211 air compressors operated by 3 hp, 1,740 rpm, 220/440 volt, 3 phase, 60 cycle induction motors manufactured by the Allis-Chalmers Company (visible in photograph MT-105-A-17). The accumulator tank for Unit 5 was

* Note that the final construction report specifications rate each of the original turbines at 137,500 hp output at 152 foot head (Roberts et al. 1960:56), while the manufacturers plates at Noxon rate each of the units at 130,800 hp output at 152 foot head.

manufactured in 1977 and is rated to a maximum design pressure of 1,100 psi at 600 degrees Fahrenheit and a working pressure of 1,000 psi. High pressure air is supplied to the Unit 5 accumulator tank by two Ingersoll-Rand T30 model 223x5 air compressors operated by 3 hp, 1,730 rpm, 220/440 volt, 3 phase, 60 cycle induction motors. One induction motor is manufactured by US Electric Motor and one is manufactured by Baldor. See photographs MT-105-A-16 and MT-105-A-17.

Station Service and Motor Control Center

Station electrical service is controlled by two Federal Pacific Electric 440 volt power centers that are interlocked and remote controlled from the main switchboard. These two power centers are virtually identical in appearance and feed four Federal Pacific Electric motor control centers, which contain breakers from 30 amperes to 400 amperes. The motor control centers and power centers control 12 normal lighting panels, one emergency lighting panel, three 440 volt distribution panels, three 125 volt direct current (DC) panels and 94 motor and feeder circuits throughout the powerhouse, dam and switchyard. The three 125 volt DC panels operate independent of the AC station service system. The power centers and motor control centers were purchased by Ebasco from Federal Pacific Electric of St. Louis, Missouri (Roberts et al. 1960:63). See photograph MT-105-A-18.

Heat Pump

The heat pump system is located between turbine Unit 1 and the main shop. The heat pump system is operated by two circulating pumps, one powered by a 7 1/2 hp motor and the other by a 5 hp motor. A model 5H60A219 compressor with a 50 hp, 220/440 volt General Electric motor is also attached to the heat pump and station air system (Roberts et al. 1960:61). The system uses the medium of warm water in the winter and chilled water in the summer furnished by a heat pump manufactured by the York Corporation. The heat pump consists of a compressor, condenser, chiller, refrigerant piping and controls, hot gas bypass and miscellaneous accessories. Water from the generator air coolers is used for the heat pump in the winter and the service water is used in the summer months. The air handling units are suspended from the ceilings and air is supplied to the plant through conventional ducts and grilles. The heating and ventilating systems were installed under contract NRC-70 by Morgan Electric Company (Roberts et al. 1960:32). See photograph MT-105-A-19.

Station Unwatering Pumps and Sump Pump

The powerhouse is equipped with two unwatering pumps and one station sump pump. The two unwatering pumps are 5,000 gpm Layne-Bowler Verti-Line pumps each powered by a 200 hp, 1,770 rpm, 440 volt, 50/60 cycle, 250/235 amp General Electric induction motors. The station sump pump is a 1,000 gpm Layne-Bowler Verti-Line pump powered by a General Electric 40 hp, 1,770 rpm, 220/440 volt, 60 cycle 98.6/49.3 amp electric motor. These unwatering and low level drainage system pumps provide for unwatering of the draft tube scroll case and penstock, rewatering drain line for the draft tubes, drainage of the downstream inspection gallery, and pumping from the main sump. Draft tube unwatering is through a 16" pipe discharging into a 20" header at elevation 2109, which then drains into the main sump. Scroll case and penstock unwatering is through a 12" pipe discharging into the unit draft tube. Each turbine unit is equipped with its own penstock drain valve. A 12" re-watering line is valved to allow filling of the draft tubes. The unwatering and sump pumps are located in the main shop area (Roberts et al. 1960:64-65). See photograph MT-105-A-20.

Greasing System

Each turbine unit is equipped with an automatic centralized, motor driven, adjustable, time clock controlled, forced grease Farval Model DC-25, Series 93-A lubricating system manufactured by the Farval Corporation. Each greasing unit has a Farval Model T4C, Series 5A, 200 pound grease reservoir and is powered by a 1 hp, 220/440 volt, 3 phase, 60 cycle, 1,740 rpm electric motor manufactured by the Reliance Electric Company. The hydraulically operated valves within the system are regulated by a 220 volt Oviatt Control unit, that provides for indication and adjustable measuring of the lubrication. The greasing system provides lubrication for the wicket gate stem bearings, gate linkage bearings, the gate operating ring and servo-motor connecting rods within the turbine pits (Roberts et al. 1960:56). See photograph MT-105-A-21.

Depressed Level Control System

The draft tube water level depressing system, or blow down system, permits the motoring of a unit when it is not required for power production. The system has a 6" and a 2" supply line connection to the main 8" compressed air header which conveys air to the draft tube. Air through the 6" line is regulated by a Fisher Type 5701-B diaphragm control, 150 pound class, with an integrally mounted 3/8" Asco Type 834425, 4-way solenoid pilot valve, 115 volt and a No. 67-FR air set. Air through the 2" line is regulated by a Climax Type 86

diaphragm operated control valve, 150 pound class, with a 1/4" Asco Type 830059-R, 3-way solenoid pilot valve, 115 volt. The solenoids are activated by a 115 volt DC control circuit, which allow compressed air from the instrument air supply to operate the diaphragms of the 6" and 2" valves. Instrument air for the 6" valve is 50 psi and 20 psi for the 2" valve. Installation of the depressed level control system was made by the Morgan Electric Company under contracts NCR-70 and NCR-86 (Roberts et al. 1960:60-61). See photograph MT-105-A-22.

Station Air System

The station air system consist of three compressors, three compressor motors and six accumulator tanks (Figures 5-6). The system is used for depressing water in the draft tubes, operating the intake and spillway bubbler system, and for providing service air. Two C-200-200-H two stage, water jacketed 1041 CEM Fuller Rotary Compressors powered by two 200 hp, 575 rpm, 440 volt, 3 phase, 60 cycle, open NEMA sleeve bearing, squirrel cage induction motors are used for depressing the draft tube water level. The original station service air compressor was a C-15-15-H two stage, water jacketed Fuller Rotary Compressor powered by a 30 hp, 1,750 rpm, 440 volt, 3 phase, 60 cycle, open NEMA sleeve ball bearing squirrel cage induction motor. The current station service air compressor is an Ingersoll-Rand type 40 compressor powered by a General Electric 30 hp, 1,770 rpm, 220/440 volt electric motor. The compressors are connected to six receiver tanks. Each tank measures 12' 6" tall by 8' diameter and has a maximum design pressure of 100 psi. The receiver tanks were manufactured in 1957 by the Missouri Boiler and Sheet Iron Works. The station air compressors and receiver tanks are located in three rooms adjacent to the main shop. (Roberts et al. 1960:65). See photograph MT-105-A-23.

Oil Tanks and Pumps

The central oil lubricating system consists of a lubricating oil pump and a station transil oil pump located in the oil storage room. The lubricating oil pump is operated by a 3 hp, 1,740 rpm, 3 phase, 60 cycle, 220/440 volt, electric motor. A second motor serves as an emergency backup unit for the pump. This unit supplies oil to all systems throughout the powerhouse, including the governors. The transil oil pump is also a 3 hp, 1,740 rpm, 3 phase, 60 cycle, 220/440 volt motor. The pumps are connected to two 9' high, 9' diameter, 4,275 gallon capacity lubricating oil storage tanks (one clean and one dirty oil) located in the oil storage room. Lubrication of the main shaft guide bearing is provided by pump circulation through the bearing between clean and dirty lubrication oil

tanks in the oil room (Roberts et al. 1960:56). Two 2" oil pipes (one clean oil supply and one dirty oil return) run between the oil room and the guide bearings and governor housings are located below the deck plating along the rear corridor (Ebasco 1975). Two 10' high, 9' diameter, 5,000 gallon capacity transformer oil tanks (one clean and one dirty oil) are also located in the oil storage room. A General Electric transformer oil dryer and filter model number D319286, Type FP-30, with a 12" diameter 30 gpm capacity is located along the south wall of the oil room. See photograph MT-105-A-24.

Station Control Batteries and Chargers

The powerhouse was originally equipped with 60 Exide-Manchex type EMP-15 electric storage batteries housed in the battery room on 12' long 2-step racks. The storage batteries were supplied by the Electric Storage Battery Company of Philadelphia, Pennsylvania. The batteries were charged by a Raytheon recticharger RB130N25 with 3 phase, 60 cycle, 440/480 volt input and adjustable output of 0 to 25 amps at voltages from 111.8 to 137.5 DC (Figure 7). The station control batteries powers the station control emergency lighting and a 2,500 watt, 115 volt, single phase, 60 cycle Katolight rotary converter for emergency AC control (Roberts et al. 1960:64).

The 60 Exide-Manchex batteries were replaced in 1979 with 60 KCU-7 lead calcium batteries manufactured by C&D Batteries, a Division of Eltra Corporation, Conshohocken, Pennsylvania. The Recticharger battery charger was supplemented in 1966 with a model A-40 automatic battery charger manufactured by LaMarche Manufacturing Company of Des Plaines, Illinois. Both the Recticharger and the A-40 were relegated to back-up battery chargers in 1979 when a 240/480 AC volt, 35/15 AC amp, 132 DC volt, 50 DC amp, model ARU130HK50 battery charger was installed. The ARU130HK50 was manufactured by C&D Charter Power Systems, a division of Eltra Corporation, Plymouth Meeting, Pennsylvania. The battery chargers are located in the battery room. See photograph MT-105-A-25.

Air Blast Circuit Breaker Compressors

The air blast circuit breaker compressors are composed of two Westinghouse air compressors operated by two 3 hp, 1,740 rpm, 220/440 volt, 3 phase, 60 cycle electric motors that rest atop two 4' 4" high by 18" diameter air receiver tanks. The compressors supply air to the Westinghouse outdoor type 150-CA-5,000, 14.4 kv, 5,000 ampere, 3 phase, 60 cycle compressed air, pneumatically operated circuit breakers located on the roof deck. Each of the generators is connected to the main bus at each transformer bank by one of these circuit

breakers. The circuit breaker (located on the roof deck) break the electrical connection between the main bus and the transformer by means of an air blast from the compressor tanks (located in switch gear room [i.e. motor control room] number 1. The circuit breakers were supplied by Westinghouse Electric Corporation. See photograph MT-105-A-28.

Generator Fire Protection

Fire protection for generator Units 1 through 4 is provided by a high pressure carbon dioxide system purchased from the C-O-TWO Systems Division of the Fyr-Fyter Company of Newark, New Jersey (Figures 8-9). The system consists of thirty-eight 100 pound cylinders of carbon dioxide gas located on the pipe floor between Unit 2 and Unit 3 turbine pits. The system is controlled by heat detectors within the stator housing and provides for automatic or manual operation, with critical temperature for discharge set at 225 degrees Fahrenheit. When activated, 25 of the cylinders are discharged within 15 seconds and the remaining 19 cylinders sustain the concentration of carbon dioxide within the generator barrel for a 10 minute period.

Fire protection for the Unit 5 generator is provided by a low pressure carbon dioxide system located between units 2 and 3, adjacent to the high pressure system. The system consists of a Cardox five ton carbon dioxide tank model D18256-6 manufactured by the Fire Systems Division of the Chemetron Corporation of Chicago, Illinois. Normal pressure of the system is 290-310 psi. The low pressure unit was installed in 1976. See photograph MT-105-A-31.

Instrument Air System

The original instrument air system reservoir tank was 4' 4" high and 18" in diameter and received air from a 100 psi 8" compressed air header in the station air system. Pressure reducers lowered the air pressure to 50 psi and 20 psi for use in the instrument air system. The 50 psi air is used for operating 6" air control valve diaphragms on the tailwater depressing system, for maintaining constant air pressure on the water being circulated in the heat pump system and for operating the automatic controls associated with the heat pump installation. The 20 psi air is used for operating the 2" diaphragms in the tailwater depressing system and a purge type oil level indicator for the turbine guide bearing oil sump. The original instrument air system was installed by the Morgan Electric Company under contract NRC-70. The air reservoir tanks were purchased from Modern Welding Company on purchase contract NY-90287

and most of the system pipe and fittings were purchased from Palmer Supply Company on purchase contract NY-90297. (Roberts et al. 1960:61). The original system was replaced in the mid 1980s, except for one of the receiver tanks.

The current instrument air system was installed in the mid 1980s and consists of two 4' 4" high by 18" diameter air receiver tanks (one of which is the original air receiver tank). The original receiver tank is located along the east (back) wall between Units 3 & 4 (visible in photograph MT-105-A-17) and the other receiver tank is located under the new air compressor unit. The air compressor unit is located between Units 1 & 2 and consists of two Ingersoll-Rand model 5T2NL air compressors rated at 78-95 psi at 100 degrees Fahrenheit. The compressors are operated by two 5 hp, 1,450 rpm, 60 cycle, 230/460 volt electric motors manufactured by Marathon Electric Motors. The current instrument air system is not original equipment and was not photographed.

IV. HISTORICAL INFORMATION

Noxon Rapids is an earth fill dam with integral concrete powerhouse and concrete spillway located on the Clark Fork River approximately 38 miles downstream from Thompson Falls, Montana. The Noxon Rapids and Cabinet Gorge dams were not intended to work together to produce power for the same generation system. After the Noxon Rapids Dam was completed, it was realized the dam produced a higher flow of water. The Noxon Rapids Dam now helps to maintain a steady flow of water to the Cabinet Gorge Dam and Reservoir.

Noxon Rapids, the site where the dam is located, was investigated by the Army Corps of Engineers as a possible dam construction site as early as 1944. World War II had caused an industrial boom in the Pacific Northwest, and new power supplies were in high demand. By 1948, the power supply problem had become so acute that shortages occurred during peaking hours. By the end of 1952, when Washington Water Power (WWP) acquired the rights for building a dam at Noxon Rapids, not only was the demand for more power still not fully met, WWP was in the midst of major changes.

Just three years earlier in 1949, American Power & Light (AP&L), the New York based holding company that owned WWP, had tried to divest itself of WWP by selling it to public utilities in the region. Only prompt legal action to block the sale by WWP President, Kinsey Robinson, saved the company. Early in 1952, WWP obtained its financial independence from AP&L. A few months later WWP had completed construction of Cabinet Gorge. Thus, 1952 was a pivotal year for Washington Water Power. By 1954, WWP was challenging its public utility

rivals at all levels, from pricing to customer service. By 1955, the year construction began on Noxon Rapids, WWP had earned its third Coffin Award, this time for service excellence (Blewett 1989:47). Construction at Noxon Rapids, meanwhile, was starting.

Ebasco, which had conducted construction at Cabinet Gorge four years earlier, was once again hired by WWP for design and oversight of construction at Noxon Rapids. In addition to construction of the dam, approximately 8800 acres of reservoir needed clearing, 30 miles of state and county roads needed relocating, 24 miles of Northern Pacific railroad track needed relocating, as well as existing power and telephone lines (Roberts et al. 1960:3). The construction timetable of Noxon Rapids, however, was not as frenzied as it had been for Cabinet Gorge and the project was well under way by late 1955.

The first three turbine units at Noxon Rapids went on-line four years later, in 1959. By 1960, the fourth unit was on-line. The turbines drew power from Noxon Reservoir, which stands 38 miles long and 1.3 miles wide at its widest point. Total storage capacity of the reservoir is an impressive 400,000 acre ft of water, with an active storage in the top 10 feet of approximately 80,000 acre feet (n.a. 1997:A-5). The reservoir not only altered the landscape of the region, it also altered the economy of the region. The WWP Company created a new tax base for Sanders County with completion of the dam. The subsequent reservoir also started drawing increased numbers of people into the area interested in recreational and sporting activities. These actions have significantly influenced the history of Sanders County to the present day.

V. SOURCES

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